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1801 Pennsylvania Avenue, NW
Washington, DC 20006

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

February 9, 1999

Magalie Roman Salas, Secretary
Federal Communications Commission
1919 M Street, N.W., Room 222
Washington, D.C. 20554

Re: Ex Parte Submission
Federal-State Joint Board on Universal Service; CC Docket No. 96-45
Forward-Looking Mechanism for High Cost Support for Non-Rural LECs; CC Docket No. 97-160

Dear Ms. Salas:

On February 8, 1999, Richard Clarke, Mike Lieberman, and Cathy Petzinger of AT&T and Chris Frentrup of MCI WorldCom met with Craig Brown, Paula Cech, Bryan Clopton, Abdel Eqab, Katie King, Bob Loube, Jeff Prisbrey, Richard Smith, and Adrian Wright of the Common Carrier Bureau. We presented them with the CD-ROM included with this filing, which contains the revisions to the HAI components of the Commission's Synthesis Model that are outlined in the attached document. Also attached is a discussion of several input issues for the Commission's Synthesis model, as well as decision documents supporting the use of HAI default inputs from state proceedings in Nevada and Minnesota. Finally, we include a document filed by Bell South in a state proceeding in Florida, which supports the proposition that a minimum spanning tree approach to customer location when surrogate locations are used overstates the distribution plant needed to meet actual customer locations. Please associate these items with the above-captioned dockets.

Respectfully submitted,

Chris Frentrup

Chris Frentrup
Senior Economist
MCI WorldCom
1801 Pennsylvania Ave., NW
Washington, DC 20006
(202) 887-2731

cc: Craig Brown, Paula Cech, Bryan Clopton, Abdel Eqab, Katie King, Bob Loube, Jeff Prisbrey, Richard Smith, Adrian Wright - Documents only
Sheryl Todd, ITS - Documents and CD

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Input Value Issues

This submission provides guidance on AT&T and MCI WorldCom's views about: (1) certain unresolved input value issues surrounding the Commission's Synthesis Model ("SM") for universal service costs; and (2) the credibility of certain suggestions that have been made by various ILECs concerning SM input values.

This discussion will be ordered by model segment: distribution and feeder outside plant ("OSP") structures and materials, SAIs, DLCs, end office switching, interoffice transport, signaling, repair and maintenance expenses, network operations expenses, corporate overhead expenses, and depreciation. First, we summarize our positions on the unresolved portions of these issues, and add further support to our positions as may be available. Second, we evaluate the credibility of recent ILEC comments on, and suggestions for, dealing with these inputs issues.

In general, we find the analytic methods and "data" proffered by the ILECs to lack consistency in their application. Rather than keep to consistent forward-looking couplings of current efficient unit costs scaled to serve current demand, the ILECs frequently suggest the use of idiosyncratic historical cost records when they exceed current costs, and current costs when they exceed historical costs. In addition, the bias from this "heads it costs more, tails it costs more" pattern of data selection may be further exacerbated by ILEC suggestions that certain of these costs be scaled to pay for growth demand -- without properly reflecting this increased demand in service quantity denominators.

Similarly worrisome are ILEC requests to base national input values on proffered "data" from one or two ILEC study areas.[1] Handpicked "data" offered by individual ILECs in possession of more complete data, or from only a small subset of the many ILECs, should be afforded no presumption as to its representative nature.

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1 These individual study areas-worth of data typically do not even comprise the complete set data available to the particular ILEC holding company proffering them – let alone available to the much larger and more diverse complete ILEC industry.

1 OSP issues

1.1 Plant lengths

An issue exists as to the proper calculation of lengths of the distribution cables required to reach to all customer locations. Currently, the SM uses a combination of actual and surrogate geocodes to define customer locations, and then constructs distribution plant on a rectangular-routing basis to connect these customer locations to aggregation points. This should result in the SM assuming an implicit route/air multiplier (RAM) of about $4/\pi$, or 1.27. We believe this provides an adequate to generous sizing of the required distribution route distance. There are several reasons. The first is that the MST associated with linking these customer locations is likely to overstate the minimum linking distance. The second is that the spatial characteristics of distribution areas are likely to make a RAM of 1.27 an excessive adder.

1.1.1 *Use of MST as a target basis*

Although Sprint and several other ILECs have attempted to argue that the MST linking a set of points represents the absolute minimum distribution route distance required, this is false both factually and in its implementation using the SM's geocode points. First, graph theory demonstrates that a Steiner network using junction points requires less link distance to connect all of the location points than does an MST network. Furthermore, the distance savings using Steiner over MST are greatest in situations where points are sparse (e.g., in rural areas), and may amount to as much as 13%. Second, because the SM uses surrogate geocode points in addition to actual geocode points, distances between its points are artificially enlarged due to the operation of the surrogation algorithm. Thus, even if MST represented the minimum distance to link the *given* (actual plus surrogate) location points, this distance will exceed significantly the true MST that would be calculated if *all* customers are geocoded to their *actual* location points. This gap is likely to be larger in the lower density zones where the surrogate percent is larger. Comparison of the PNR all road surrogate MST with the MST of the actual plus road surrogate geocodes in AT&T and MCI WorldCom's ex parte submission of June 10, 1998 demonstrated this and showed they typical surrogate enlargement of within-cluster distances may lead to a 19.4% overstatement of required cable lengths.[2] Thus, it is reasonable to expect that due to potential Steiner efficiencies and surrogate enlargement, the distribution route distance required to link all customers at their actual locations could be at least 25% less than the MST of the given data points.[3]

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2 The BCPM sponsors appear to agree. An INDETEC exhibit in a Florida PUC proceeding (Docket 980696-TP), looking at a single wire center's 100% road surrogate versus satellite-derived actual point locations, demonstrated a 26% increase in computed MST when road surrogate points were used relative to the MST computed from the satellite actual points.

3 Because the Commission has both actual/surrogate and all surrogate customer location data from PNR, it can compute the RAM overstatement implied by surrogate enlargement of link distances.

1.1.2 Sizing of a route/air multiplier

Because the true non-rectangular-routed (beeline) minimum distance for connecting all customer locations within a distribution area may be, roughly 75% of the given points' (actual plus surrogate) MST, inflating the given points' MST to 127% of its initial value through the application of rectangular routing yields an implicit RAM of 1.69 (= 1.27/0.75) in the SM.[4] This is likely to be a significant overstatement of the RAM necessary to allow for cable routes to follow rights-of-way and skirt obstacles, etc. Indeed, because distribution areas are formed by a clustering algorithm that attempts only to aggregate closely situated points, and/or to divide distantly situated groups of points, it is likely that identified distribution areas generally will not contain significant barriers to the beeline routing of cables. This is because the existence of any such barriers would tend to cause points located on opposite sides of such a barrier to be divided into separate clusters/distribution areas.

1.2 Structure sharing

1.2.1 Aerial Plant

The most readily observable cases of structure sharing involve aerial plant attached to poles. AT&T and MCI WorldCom suggest that the FCC apply the same approaches taken in CC Docket No. 97-151; and specified its *Report and Order*, adopted and released February 6, 1998, titled, "Amendment of the Commission's Rules and Policies Governing Pole Attachments.

In this order, the Commission recognized pole attachers as being power companies, ILECs, CLECs, CATV system operators, and other attachers such as municipalities.[5] The order governs the rates that pole owners can charge to telecommunications users if negotiations fail to reach a mutually agreeable rate.

Different formulae are adopted in this pole attachment order to govern the allocation of the cost of usable space on a pole (presumptively assumed to cost 36% = 13.5 ft / 37.5 ft of the total cost of the pole) and nonusable space (presumptively assumed to cost 64% = 24 ft / 37.5 ft of the total cost of the pole).[6] Attachers are responsible for sharing equally the costs of 2/3 of the nonusable space; and for paying for a share of the usable space costs equal to the proportion

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4 Note that is possible that the application of rectangular routing alone is sufficient to overestimate required cable amounts. For example, assume houses in a cluster are distributed along a straight road that runs diagonally to the coordinate system used by the model. This road will intersect a diagonal string of grids, and the SM will assume rectangular routing to reach these grids. So in actuality, the cable would be run diagonally along the road, but the SM's rectangular routing will replace this straight cable with a "stair step" cable, or several cables, of considerably greater length.

5 Municipalities' may use poles for telecommunications services, in addition to street lighting, fire alarm boxes, decorations, and traffic signaling systems.

6 See, "Implementation of Section 703(e) of the Telecommunications Act of 1996 – Amendment of the Commission's Rules and Policies Governing Pole Attachments," CS Docket No. 97-151, *Report and Order*, Adopted and Released: February 6, 1998, ¶ 22.

of the usable space that their attachments occupy (which presumptively is one foot).[7]

Consider, first, the situation where the ILEC attaches to poles owned by power utility The following table shows the *maximum* rates that the ILEC could be charged.[8]

No. of Telecom Attachers	ILEC Share of Unusable Space Cost	ILEC Share of Usable Space Cost	Share of Total Pole Cost Borne by ILEC	Probability of Occurring	Weighted ILEC Usage Cost
1	66.7%	7.4%	45.3%	10%	4.5%
2	33.3%	7.4%	24.0%	70%	16.8%
3	22.2%	7.4%	16.9%	10%	1.7%
4	16.7%	7.4%	13.3%	5%	0.7%
5	13.3%	7.4%	11.2%	3%	0.3%
6	11.1%	7.4%	9.8%	2%	0.2%
Total				100%	24.2%

If the ILEC is the pole owner (and power companies are assumed to use 8 feet of space for their wires and for safety space), the following table shows the allocation of cost

No. of non-ILEC Attachers	ILEC Share of Unusable Space Cost	ILEC Share of Usable Space Cost	Share of Total Pole Cost Borne by ILEC	Probability of Occurring	Weighted ILEC Usage Cost
1	33.3%	40.7%	36.0%	10%	3.6%
2	33.3%	33.3%	33.3%	70%	23.3%
3	33.3%	25.9%	30.7%	10%	3.1%
4	33.3%	18.5%	28.0%	5%	1.4%
5	33.3%	11.1%	25.3%	3%	0.8%
6	33.3%	3.7%	22.7%	2%	0.5%
Total				100%	32.6%

Thus, no matter which of the above two instances occurs, it is reasonable to expect structure sharing of poles to result in an assignment of not more than 33% of the cost to the ILEC.

7 Ibid., ¶ 43, 80, and summarized in n. 313 and n. 315.

8 Typically, poles will be occupied by CATV, in addition to ILECs and power utilities. The 1996 Telecommunications Act revokes the special pole attachment rates previously enjoyed by CATV providers, and requires that they be treated as any other telecommunications attacher. Furthermore, CATV use of poles is pervasive. "The Commission has determined that there are 61,700,000 subscribers in the United States." §164 FCC 98-20.

1.2.2 Buried and Underground Plant:

The same Commission Order in CC Docket No. 98-20 adopts a construct quite similar to that advocated by AT&T and MCI WorldCom for determining costs of occupying an underground conduit duct. This formula assigns cost based on share of actual space occupied, along with an allocation of common unusable space, which it defines as the cost of excavating, placing, and restoring trenches and duct bank excavations.

1.3 Cable materials costs

1.3.1 Copper

In examining a variety of information, the Commission staff has focused on the use of the NRRI report which examined publicly available data from 12,679 records of unit costs for labor and materials associated with installing various outside plant facilities, as provided by the Rural Utilities Service ("RUS").

AT&T and MCI WorldCom support the use of this publicly available data for outside plant; however, some modifications need to be made to make the results from this analysis consistent with engineering practices in the SM. The NRRI Report indicates that splicing and engineering costs should be added to its results. In addition, the cable cost observations in the NRRI Report comprise almost exclusively 24 gauge wire.[9] Because the improved transmission characteristics of 24 gauge wire is not required for all but the extremely long cable runs needed in more rural areas,[10] it is unlikely that a cable containing 400 or more pair will need to be 24-gauge.[11] Furthermore, cables above 2400 pair are not even manufactured other than in 26-gauge size. AT&T and MCI WorldCom have recommended adoption of a 24-gauge standard for cables smaller than 400 pairs, cables of 400 pairs and larger should be 26-gauge. AT&T and MCI WorldCom propose a method to adjust the NRRI report parameters to recognize the lower material cost associated with thinner gauge copper wire.

1.3.1.1 Proposed Method to adjust 24-gauge to 26-gauge Copper

Since 26-gauge cable material is less expensive than 24-gauge cable, its material costs are less. AT&T and MCI WorldCom agree with Dr. Gabel and the Commission staff's proposal that the relative weight of copper be used to adjust the "per pair" parameter in its regression equation. This is logical because the cost of copper cable is directly proportional to the amount, i.e. weight, of metallic copper in the cable.

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9 During the December 11, 1998 workshop on outside plant inputs, Dr. Gabel stated that the NRRI report results were based on 24-gauge cable for all of its sampled cable sizes. An examination of the actual data available on the NRRI website verifies that this is true.

10 In the SM, 24-gauge cable is not used unless cable runs exceed 12,000 feet.

11 The standard cable used in the proposed proxy models has been 26-gauge cable, rather than 24-gauge cable. 26-gauge wire is thinner than 24-gauge copper wire.

The second issue is to determine how the regression coefficients can be adjusted for cable sizes of 400 pairs and larger. The NRRI report provides guidance in this area:

AT&T and MCI WorldCom recommend that the Gabel/Staff proposal for copper cable costs be adopted, but that the installed costs for copper cable of 400 pairs and larger be adjusted to account for the lower cost of 26-gauge wire that these cables would employ based on the comparative physical weights of 26- and 24-gauge cables.

The following information, obtained from the AT&T Outside Plant Handbook, August 1994 should be used to determine the relative weight difference between 26-gauge and 24-gauge cable.[12] These data demonstrate that the appropriate ratio to use in adjusting downward the 24-gauge length coefficient proposed by NRRI and the Commission staff is 65%.

Copper Weight Ratio of 26 Gauge to 24 Gauge[13]				
Pairs	Cable Code	Pounds per Foot 24 Ga.	Pounds per Foot 26 Ga.	26/24 Ga. Ratio
400	GFM(T)W	1.75	1.15	65.7%
600	GFM(T)W	2.59	1.73	66.8%
900	GFM(T)W	3.80	2.47	65.0%
1200	DCM(T)Z	3.74	2.41	64.4%
1800	DCM(T)Z	5.49	3.52	64.1%
2400	DCM(T)Z	7.24	4.64	64.1%
			Average	65.0%

Also, the coefficient per 1000 ft. for Aerial copper cable of *9.67289* recommended by the Commission staff based on the NRRI Report Table 2-15, *"Regression Results: Cost of Installing Aerial Copper Cable,"* should be changed to *9.425349* based on the NRRI Report Table 2-16, *"Regression Results: Cost of Installing Aerial Copper Cable (with density variables dropped)"*. This is consistent with what appears to be NRRI's recommendation that Table 2-16 be used, rather than Table 2-15, to mitigate the unusual findings of Table 2-15 wherein the cost of placing aerial cable is lower in higher density zones than in lower density zones.[14]

12 These pages are attached as Appendix A.

13 AT&T Outside Plant Handbook, August 1994, pgs. 14-10 (DCMZ & DCTZ) and 14-23 (GFMW & GFTW).

14 "These parameter estimates [Table 2-15] suggest that the cost of installing aerial cable decreases as density increases. This could be due to two factors: (1) there was data for only one company in this density range, North Pittsburgh Telephone Company, and there is something that makes its costs lower than what one would expect for this density range; or (2) there may be less traveling time involved in this density zone, and therefore their costs are lower.

1.3.1.2 Additional Cost of Splicing

The cost of splicing was estimated by the NRRI analysis as 9.4 percent adder to cable investment.[15] AT&T and MCI WorldCom believe that this approach is incorrect for the SM, and will lead to an inaccurate and inflated estimate for splicing investments.

First, splicing costs are not directly a function of investment; and second, the data used in the NRRI analysis were based primarily on use of RUS Cable Splicing Assembly Units designated HC-1, "using individual mechanical splicing connectors,[16]" rather than the more appropriate, and significantly more productive and forward looking method designated HC-3, "using splicing modules".[17] Whereas the installed cost of copper cable, without splicing and engineering can be represented as a linear function of total cable length, splicing cost is primarily a function of the number of pairs to be spliced, and the distance between splices. But there is collinearity between these two variables. As cables contain higher pair counts, the cable's diameter increases and the maximum amount of cable that can be placed on a standard No. 420 reel declines.[18] Thus, splicing costs rise as the number of pairs in a cable rise.

A minimum cost construct would assume that cable splices are needed only to join maximum lengths of copper cable.[19] The following table demonstrates the percent that splicing would be of cable investments under such a construct.

An alternative view is that the cost of placing aerial cables is independent of population density. At the 1 percent level of significance, the hypothesis that there is no statistically significant difference in the cost of placing cables in the two density zones can be accepted. In the regression results below in Table 2-16, the density variables have been dropped." See, NRRI Report, p. 57.

15 NRRI Report, p. 29, *"Splicing"*.

16 See, RUS REA Bulletin 345-153/REA Form 515f, "Specifications and Drawings for Construction of Pole Lines, Aerial Cables and Wires", Section HC, p. 6.

17 Ibid., p.7. Modular splicing was the method demonstrated to the Commission staff by AT&T and MCI WorldCom in our ex parte meeting of January 20, 1999.

18 See AT&T Outside Plant Handbook, August 1994, pgs. 14-23 and 14-40. Attached as Appendix A.

19 Note that for smaller distribution cables, block terminals are spliced into the cable. But, the cost of that splicing is included in the cost of the block terminal. Thus, no additive to cable costs is required to reflect the cost of block terminal splicing.

Splicing Cost per Foot										
	Standard Length (ft)			Splicing Labor						
Pairs	DCTZ	GFMW & GFTW	WA4AR	Splice Setup (hrs)	Wire Work @ 300 Pairs/hr	Total hrs	Cost/ Splice @ $55/hr	Splicing Cost per ft	HAI Default $/ft	Splicing Cost to HAI $/ft
6			10,000	0.5	0.1	0.6	$33.00	$0.003	$0.63	0.5%
12			10,000	0.5	0.1	0.6	$33.00	$0.003	$0.76	0.4%
25		15,050		1.0	0.2	1.2	$66.00	$0.004	$1.19	0.4%
50		15,050		1.0	0.2	1.2	$64.17	$0.004	$1.63	0.3%
100		10,000		1.5	0.3	1.8	$100.83	$0.010	$2.50	0.4%
200		6,040		1.5	0.7	2.2	$119.17	$0.020	$4.25	0.5%
400		5,470		2.0	1.3	3.3	$183.33	$0.034	$6.00	0.6%
600		3,340		2.0	2.0	4.0	$220.00	$0.066	$7.75	0.8%
900		2,510		2.0	3.0	5.0	$275.00	$0.110	$10.00	1.1%
1200	2,310			2.0	4.0	6.0	$330.00	$0.143	$12.00	1.2%
1800	1,730			3.0	6.0	9.0	$495.00	$0.286	$16.00	1.8%
2400	1,390			3.0	8.0	11.0	$605.00	$0.435	$20.00	2.2%
3000	1,070			3.0	10.0	13.0	$715.00	$0.668	$23.00	2.9%
3600	860			4.0	12.0	16.0	$880.00	$1.023	$26.00	3.9%
4200	810			4.0	14.0	18.0	$990.00	$1.222	$29.00	4.2%
									Average	1.4%
									Median	0.8%

In a maximum cost construct, it would be assumed that cable must be spliced at much more frequent intervals. The following table reflects the case of a straight splice every 800 feet for all cable sizes.

Splicing Cost per Foot										
	Standard Length (ft)			Splicing Labor						
Pairs	DCTZ	GFMW & GFTW	WA4AR	Splice Setup (hrs)	Wire Work @ 300 Pairs/hr [20]	Total hrs	Cost/ Splice @ $55/hr	Splicing Cost per ft	HAI Default $/ft	Splicing Cost to HAI $/ft
6			800	0.5	0.1	0.6	$33.00	$0.041	$0.63	6.5%
12			800	0.5	0.1	0.6	$33.00	$0.041	$0.76	5.4%
25		800		1.0	0.2	1.2	$66.00	$0.083	$1.19	6.9%
50		800		1.0	0.2	1.2	$64.17	$0.080	$1.63	4.9%
100		800		1.5	0.3	1.8	$100.83	$0.126	$2.50	5.0%
200		800		1.5	0.7	2.2	$119.17	$0.149	$4.25	3.5%
400		800		2.0	1.3	3.3	$183.33	$0.229	$6.00	3.8%
600		800		2.0	2.0	4.0	$220.00	$0.275	$7.75	3.5%
900		800		2.0	3.0	5.0	$275.00	$0.344	$10.00	3.4%
1200	800			2.0	4.0	6.0	$330.00	$0.413	$12.00	3.4%
1800	800			3.0	6.0	9.0	$495.00	$0.619	$16.00	3.9%
2400	800			3.0	8.0	11.0	$605.00	$0.756	$20.00	3.8%
3000	800			3.0	10.0	13.0	$715.00	$0.894	$23.00	3.9%
3600	800			4.0	12.0	16.0	$880.00	$1.100	$26.00	4.2%
4200	800			4.0	14.0	18.0	$990.00	$1.238	$29.00	4.3%
									Average	4.4%
									Median	3.9%

As indicated by either of the constructs, above, if splicing were to be determined as a percent of cable investment, it should vary between, roughly, 1% and 4.5%. Note that both these minimum and maximum values are significantly less than the 9.4% suggested by the inappropriate analysis in the NRRI Report. But even NRRI's value of 9.4%, when appropriately viewed, is not inconsistent with the above HAI analysis

The RUS database contains 160 observations containing 11,186.25 units of HC-1 costing $1,437,813.01, or an average of $128.53 per splicing unit of 100 pairs.[21] In contrast, the database contains 30 observations containing 2,200.17 units of HC-3 costing $209,837.83, or $95.37 per splicing unit of 100 pairs.[22]

20 At the January 20, 1999 ex parte meeting, AT&T and MCI WorldCom demonstrated and produced documentation indicating that modular splicing is the forward looking, yet mature technology, with typical splicing speeds of 300 pairs or more per hour, versus use of individual splicing connectors.

21 7 observations of HC-1 indicated zero units and zero extended cost; these observations, although excludable, did not effect the average cost per unit.

22 2 observations consisting of a total of only 62.25 units were excluded as being significantly out of range at costs of $435.79 and $370.00 per unit against the next most expensive observation of $230.00, and an average of $95.37 per unit. The $370 observation was aberrant due to an extraordinary material charge of $160.00 per unit for material. The $435.79 observation did not break down material and labor.

Thus, reducing the NRRI finding of 9.4% percent using the ratio \$95.37/\$128.53 to reflect the use of modern modular splicing would result in an adjusted "NRRI" splicing charge of 7.0%.[23] But because the NRRI analysis is based on RUS data that rarely include cable observations in excess of 400 pairs, this 7% value is most comparable to the 6 to 400 pair rows from the above table – which range between 4% and 7%. But because the SM expects to use a single figure that applies to *all* cable sizes, it is appropriate that this overall average not exceed the AT&T and MCI WorldCom-recommended figure of 4.4%.

1.3.1.3 Engineering Content

The NRRI report indicates, "The sponsors of the HM have claimed that engineering constitutes about 15 percent of the cost of installing outside plant cables."[24] However, the citation referred to by the NRRI report pertained to an earlier version of the Hatfield Model than the current HAI 5.0a. In this more recent and sophisticated version, the HAI Model recognizes that because at least a portion of engineering costs are fixed, engineering will comprise a relatively larger portion of the investment in small cables, and a relatively smaller portion of the investment in larger cables. The HAI 5.0a Inputs Portfolio states that the engineering team supporting the HAI 5.0a believes that it is appropriate for engineering costs to be approximately 15% of installed copper cable investment for cables below 400 pairs, and less than 15% for cables above 400 pairs.[25] In addition, costs for 6-pair and 12-pair cable were adjusted downward for very low material costs by calculating an $a+bx$ cost based on \$0.30/ft. + \$0.007/pr.-ft. and then subtracting \$0.22/ft. and \$0.20/ft. from the 6-pair and 12-pair cable investments, respectively, while keeping the direct labor and engineering components whole. Therefore engineering costs are higher than 15 percent of total investment for 6-pair and 12-pair cables.[26]

The engineering team supporting the HAI Model has identified the following breakdown of copper cable costs.

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23 BCPM recommends a 7% adder to account for splicing. See, BCPM2 folder, "table inputs", cell B44.

24 NRRI cites "Direct Testimony of Dean Fassett, In the Matter of the Pricing Proceeding for Interconnection, Unbundled Elements, Transport and Termination, and Resale, Washington Utilities and Transportation Commission, UT-960369, February 21, 1997, Exhibit, p. 21." See, NRRI Report, p. 29.

25 HAI Inputs Portfolio §2.3.2. and §3.4.1.

26 The HAI Inputs Portfolio §2.3.2., footnote 4, states, "[4] The formula would produce a material price of \$0.38/ft. for 12 pair 24 gauge cable, and \$0.34/ft. for 6 pair 24 gauge cable. An actual quote for materials was obtained at \$0.18/ft. for 12 pair 24 gauge cable, and \$0.12/ft. for 6 pair 24 gauge cable. The significant difference in material cost is perceived to be the result of the very small quantity of sheath required for 12 and 6 pair cables. Therefore, the formula generated material price was reduced by \$0.20 and \$0.22 for 12 and 6 pair cables respectively, but the engineering and labor components were retained at original formula levels, since neither would be affected by the reduction in material price."

Cable Size	Material	Total Labor	Engrg	Total	*Percent Engrg*
6	$0.12	$0.38	$0.13	$0.63	*21%*
12	$0.18	$0.44	$0.14	$0.76	*18%*
25	$0.48	$0.53	$0.18	$1.19	*15%*
50	$0.65	$0.73	$0.24	$1.62	*15%*
100	$1.00	$1.13	$0.37	$2.50	*15%*
200	$1.70	$1.91	$0.64	$4.25	*15%*
400	$2.26	$2.80	$0.94	$6.00	*16%*
600	$3.24	$3.38	$1.13	$7.75	*15%*
900	$4.71	$3.97	$1.32	$10.00	*13%*
1200	$6.18	$4.36	$1.46	$12.00	*12%*
1800	$9.12	$5.16	$1.72	$16.00	*11%*
2400	$12.06	$5.96	$1.98	$20.00	*10%*
3000	$15.00	$6.00	$2.00	$23.00	*9%*
3600	$17.94	$6.04	$2.02	$26.00	*8%*
4200	$20.88	$6.09	$2.03	$29.00	*7%*

1.3.1.4 Copper Cable Recommendations

Although AT&T and MCI WorldCom believe that the default values for copper cable investments submitted in the HAI 5.0a are the most accurate available, the following recommendation is submitted to reflect the public data in the NRRI Report as discussed immediately above.

Copper Cable Material and Placing									
Cable Size	Ga	Buried Low	Buried High	Aerial Low	Aerial High	Underground Low	Underground High	Average @ 24 ga.	Adj. to 26-Gauge
1	24	$0.63	$0.89	$0.63	$0.89	$0.63	$0.89	$0.63	
6	24	$0.68	$0.94	$0.67	$0.93	$0.67	$0.93	$0.67	
12	24	$0.74	$1.00	$0.72	$0.98	$0.72	$0.98	$0.73	
18	24	$0.80	$1.06	$0.77	$1.03	$0.77	$1.03	$0.78	
25	24	$0.87	$1.13	$0.83	$1.09	$0.83	$1.09	$0.84	
50	24	$1.13	$1.39	$1.03	$1.29	$1.05	$1.31	$1.07	
100	24	$1.63	$1.89	$1.44	$1.70	$1.47	$1.73	$1.51	
200	24	$2.64	$2.90	$2.26	$2.52	$2.32	$2.58	$2.41	
300	24	$3.65	$3.91	$3.08	$3.34	$3.17	$3.43	$3.30	
400	24	$4.66	$4.92	$3.90	$4.16	$4.02	$4.28	$4.19	$2.94
600	24	$6.69	$6.95	$5.54	$5.80	$5.71	$5.97	$5.98	$4.10
900	24	$9.72	$9.98	$8.00	$8.26	$8.26	$8.52	$8.66	$5.85
1,200	24	$12.75	$13.01	$10.46	$10.72	$10.81	$11.07	$11.34	$7.59
1,800	24	$18.82	$19.08	$15.39	$15.65	$15.90	$16.16	$16.70	$11.09
2,100	24	$21.85	$22.11	$17.85	$18.11	$18.45	$18.71	$19.38	$12.83
2,400	24	$24.88	$25.14	$20.31	$20.57	$20.99	$21.25	$22.06	$14.58
3,000*	24	$30.95*	$32.21*	$25.23*	$25.49*	$26.08*	$26.34*	$27.42*	$18.08
3,600*	24	$37.01*	$37.27*	$30.15*	$30.41*	$31.18*	$31.44*	$32.78*	$21.57
4,200*	24	$43.08*	$43.34*	$35.86*	$36.12*	$36.27*	$36.53*	$38.40*	$25.06
	a	*$0.62*	*$0.87*	*$0.58*	*$0.84*	*$0.62*	*$0.88*	*$0.61*	
	b(x)	*$0.01011*	*$0.01017*	*$0.00828*	*$0.00828*	*$0.00849*	*$0.00849*	*$0.00896*	

* Cables of this size are not manufactured in 24-gauge. Thus, the 24-gauge cost figure presented is illustrative, only. Cables above 2400 pair *must* be costed at 26-gauge. AT&T and MCI WorldCom recommend that all cables 400 pair and larger be assumed to be 26-gauge.

Copper Cable Investment					
Cable		Table 1.3.1.1.	Table 1.3.1.2.	Table 1.3.1.3.	Total
Size	Ga	Matl + Placing	Splicing	Engrg	
1	24	$0.63	$0.03	$0.12	$0.78
6	24	$0.67	$0.04	$0.13	$0.84
12	24	$0.73	$0.04	$0.14	$0.91
18	24	$0.78	$0.06	$0.16	$1.00
25	24	$0.84	$0.08	$0.18	$1.11
50	24	$1.07	$0.08	$0.24	$1.39
100	24	$1.51	$0.13	$0.37	$2.01
200	24	$2.41	$0.15	$0.64	$3.20
300	24	$3.30	$0.19	$0.79	$4.28
400	26	$2.94	$0.23	$0.94	$4.11
600	26	$4.10	$0.28	$1.13	$5.51
900	26	$5.85	$0.34	$1.32	$7.51
1,200	26	$7.59	$0.41	$1.46	$9.47
1,800	26	$11.09	$0.62	$1.72	$13.43
2,100	26	$12.83	$0.69	$1.85	$15.37
2,400	26	$14.58	$0.76	$1.98	$17.32
3,000	26	$18.08	$0.89	$2.00	$20.97
3,600	26	$21.57	$1.10	$2.02	$24.69
4,200	26	$25.06	$1.24	$2.03	$28.33

Should the Commission wish to use a straight percentage for Splicing and for Engineering in the SM, AT&T and MCI WorldCom recommend a splicing component not to exceed 5% of Material and Placing costs, averaged over all cable sizes; and an engineering component equal to 15% of Material and Placing costs, averaged over all cable sizes.

1.3.2 Fiber

The Commission staff has presented the following analysis, where the low value for fiber cable investment per foot represents NRRI Report data, and the high value for fiber cable investment per foot appears to reflect several state PUC estimates proffered into the record of this proceeding.

Fiber Cable Material and Placing								
Cable	Buried		Aerial		Underground		Average	Overall
Size	Low	High	Low	High	Low	High	of Lows	Average
12	$0.92	$1.93	$0.82	$1.93	$0.62	$1.93	$0.79	$1.36
18	$1.07	$2.29	$0.82	$2.29	$0.77	$2.29	$0.89	$1.59
24	$1.23	$2.65	$0.82	$2.65	$0.92	$2.65	$0.99	$1.82
36	$1.53	$3.38	$1.13	$3.38	$1.22	$3.38	$1.29	$2.34
48	$1.84	$4.18	$1.64	$4.18	$1.52	$4.18	$1.67	$2.92
60	$2.15	$4.93	$1.95	$4.93	$1.82	$4.93	$1.97	$3.45
72	$2.46	$5.55	$2.24	$5.55	$2.24	$5.55	$2.31	$3.93
96	$3.07	$7.10	$2.86	$7.10	$2.84	$7.10	$2.92	$5.01
144	$4.30	$9.50	$4.10	$9.50	$4.05	$9.50	$4.15	$6.83
288	$7.98	$11.69	$7.82	$11.69	$7.66	$11.69	$7.82	$9.76
a	$0.61	$2.37	$0.35	$2.37	$0.32	$2.37	$0.43	$1.40
b(x)	$0.0256	$0.0370	$0.0260	$0.0370	$0.0256	$0.0370	$0.02573	$0.0314

HAI Model default values in the past were based on an estimated fiber cable placing cost of $2.00 per foot, regardless of fiber count within the cable sheath. Extensive competition, and aggressive fiber deployment by CATV companies have substantially reduced the placing cost for fiber cable. In addition, material costs have dropped from approximately $0.05 per fiber foot to approximately $0.03 per fiber foot.

As a result of AT&T and MCI WorldCom's analysis of the extensive data available from the RUS contracts, AT&T and MCI WorldCom would support either the "Low" values that the FCC Staff has proposed based on the NRRI Report, or the average of the "Low" and "High" values proposed. In addition, the HAI sponsors expect to update the HAI Inputs Portfolio and its recommended defaults as follows to reflect these lower costs.

3.4.2. Fiber Feeder Cable: Cost per Foot, Cost per Strand – Foot

Definition: The cost per foot ($/foot) and per strand-foot of fiber feeder cable, as a function of cable size, including the costs of engineering, installation, and delivery, as well as the cable material itself. The fiber investment per strand-foot is used in estimating comparative life-cycle costs for copper and fiber feeder.

Default Values:

Fiber Feeder Investment	
Cable Size	$/foot (u/g & aerial)
216	$8.13
144	$5.75
96	$4.17
72	$3.38
60	$2.98
48	$2.58
36	$2.19
24	$1.79
18	$1.59
12	$1.40
Fiber Investment per Strand - foot	
$ 0.054 / fiber-ft.	

Support: Outside plant planning engineers have commonly assumed that the cost of cable material can be represented as an a + bx straight line graph. In fact, Bellcore Planning tools, EFRAP I, EFRAP II, and LEIS:PLAN have had the engineer develop such an a + bx equation to represent the cost of cable. As technology, manufacturing methods, and competition have advanced, the price of cable has been reduced. While 10 years ago, the cost of fiber cable was typically $0.50 + $0.10 per fiber per foot, and as recently as 4 years ago was typically $0.30 + $0.05 per fiber per foot as represented in HM 5.0a, extensive deployment of fiber, especially by CATV companies has driven the cost of fiber even lower.

The Rural Utilities Service ("RUS") supplied Dr. David Gabel (on behalf of NRRI[27]) with a substantial amount of data from actual contracts. That data is available from the NRRI Website at http://www.nrri.ohio-state.edu/. An analysis of data involving fiber cable was performed to obtain the new default values recommended for HAI 5.1

71 of 1,505 observations were excluded from the analysis (32 observations with zero footage quantities, 10 observations with zero total cost, 23 observations containing labor only without any material, 3 observations of cables with 0-3 fibers, and 3 observations with costs far outside reasonable bounds, e.g., 24-fiber cable with material cost greater than a 216-fiber cable). The remaining 1,434 observations (1,028 buried, 243 aerial, and 163 underground) were analyzed to produce the new default values for installed fiber cable.

Splicing Engineering and Direct Labor are included in the cost of the Remote Terminal Installations, and the Central Office Installations, since field splicing is unnecessary with fiber cable pulls that are as long as 35,000 feet between splices.

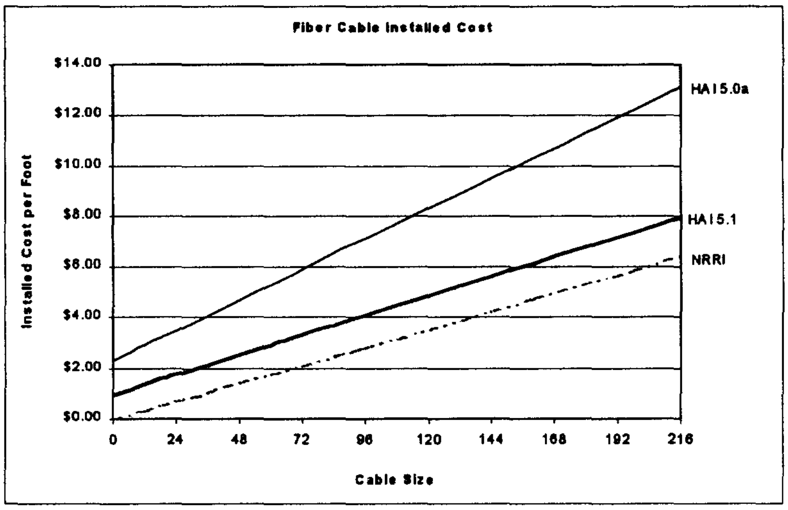
The NRRI analysis recognized that the fixed component included structure costs, or partial structure costs for buried and underground installations. NRRI then excluded the fixed component of fiber cable costs. In contrast to that approach, this analysis normalized buried data to remove the cost of buried structure, and underground data was normalized to remove the cost of innerduct

27 National Regulatory Research Institute.

structure[28]. Engineering costs were assumed to be $0.04/ft. (2,000 ft./hr. @ $75/hr.), which is simpler than copper engineering because tasks involve route layout with construction forces reporting "as built" conditions.

The analysis of 1,434 observations provided an a + bx result of $1.00 per foot plus $.032 per fiber-foot.

The following chart represents the default values used in the model HAI ver. 5.1, plus a comparison with HAI ver. 5.0a and the NRRI study.



Fiber Investment per Strand – foot:
At the point in the model where a decision is required regarding copper vs. fiber feeder, it is not possible to determine how many fibers will be aggregated along each tapered section of the feeder route. Therefore a design assumption is required to determine how much of the fixed cost of the fiber cable placement and sheath cost is distributed over the number of fibers deployed. This is approximately $0.054 per fiber strand foot in the model.

2 *SAI costs*

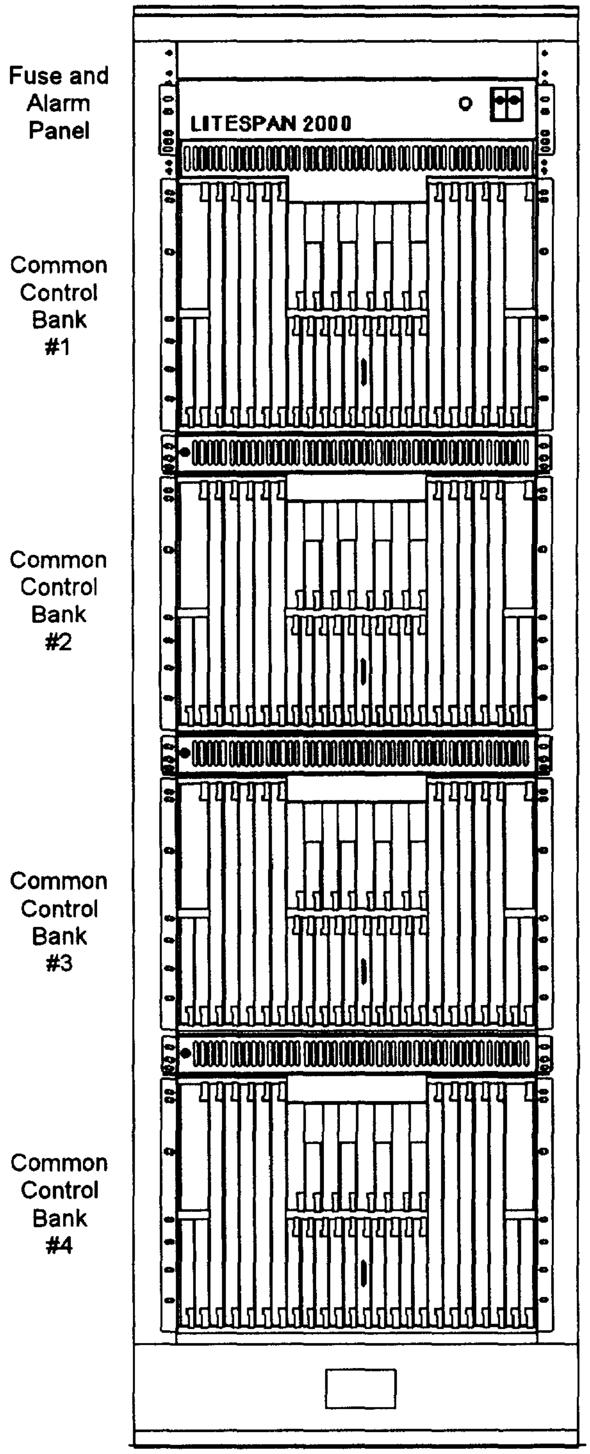
Previously demonstrated.

28 Buried fixed cost per foot was reduced by $0.88, and underground fixed cost per foot was reduced by $0.62. Installed costs per foot were as follows: Buried = $0.97 + $0.030/fiber; Aerial = $0.88 + $0.037/fiber; Underground = $1.02 + $0.032/fiber; Average all types = $0.96 + $0.032/fiber.

3 DLC costs

Litespan 2000 Central Office Terminals

COMMON CONTROL BANKS THAT HOST REMOTE TERMINALS



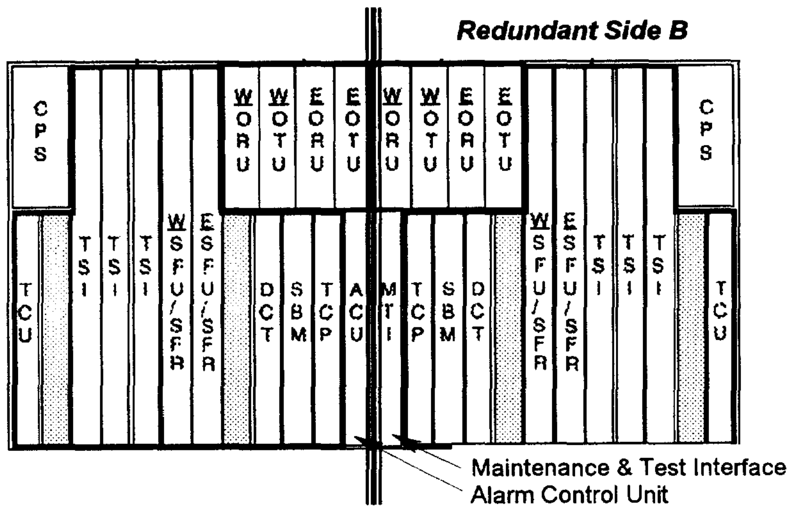
Litespan 2000 Central Office Terminal

Common Control Bank

Full Redundancy

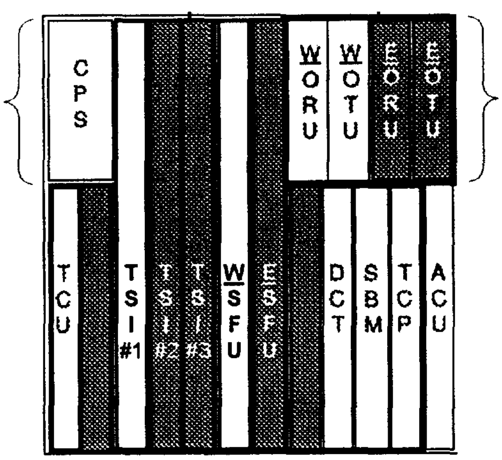
(except for ACU & MTI)

Typical Litespan 2000 Common Control Bank



One Half of Common Control Bank

Common Support Group
CPS = Common Control Power Supply
ACU = Alarm Control Unit
MTI = Maintenance & Test Interface

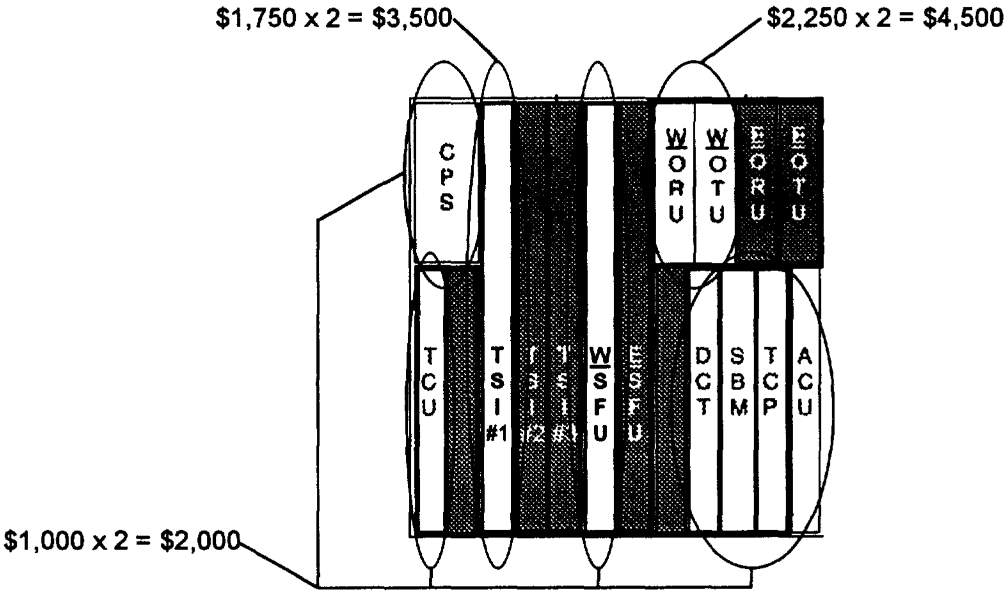


Common Optical Group
ORU = Optical Receiver Unit
OTU = Optical Transmitter Unit
W = West SONET direction
E = Optional East SONET direction
(for bi-directional rings – not modeled)

Common Equipment Group
TCU = Timing Control Unit
TSI #1 = Time Slot Interchanger (OC-1 #1: Initial 672 lines)
(W)SFU = (West direction) SONET Formatter Unit

Optional
TSI #2 = Time Slot Interchanger (OC-1 #2: Incremental Investment for 1344 lines)
TSI #3 = Time Slot Interchanger (OC1 #3): Incremental Investment for 2016 lines)
(E)SFU = (East direction) Optional SONET Formatter Unit (for bi-directional rings – not modeled)

Litespan 2000Common Control Bank Pricing



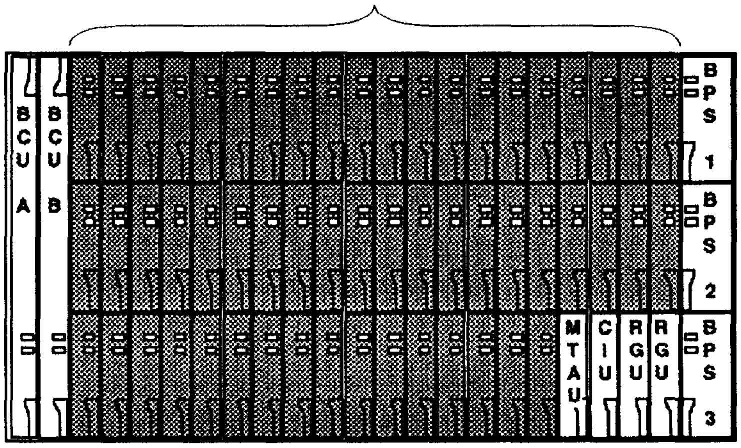
Common Control Bank [Fiber Optics Multiplexer] Pricing				
Item	Description	Quantity	Cost	Total Cost
ORU + OTU	SONET Transceivers (Receive + Transmit)	2 pr.	$2,250	$4,500
TSI	Time Slot Interchange (1 per 672 Lines)	2 ea.	$1,750	$3,500
2 ea. SFU 2 ea. TCU 2 ea. TCP 2 ea. SBM 2 ea. DCT 2 ea. CPS 1 ea. ACU 1 ea. MTI	2 ea. SONET [Ring] Formatter Unit 2 ea. Timing Control Unit 2 ea. Terminal Control Processor 2 ea. System Backup Memory 2 ea. Datalink Controller & Tone Generator 2 ea. Common Control Power Supply 1 ea. Alarm Control Unit 1 ea. Maintenance & Test Interface	1 set	$2,000	$2,000
			Total	$10,000

Central Office DLC Equipment				
Item	Description	Quantity	Cost	Total Cost
Matl	Common Control Bank	1 shelf	$10,000	$10,000
Matl	SONET Firmware (rack & multiplexer shelf)	1 shelf	$7,000	$7,000
Matl	Channel Bank Assembly w/ BCUs & BPSs	1 set	$500	$500
Matl	Digital Cross Connection Frame & Cabling	1 shelf	$800	$800
Matl	Fiber Splice Panel	1 shelf	$200	$200
Labor	Engineering hours	12.0 hrs	$55	$660
Labor	Place Frames & Racks	3.0 hrs.	$55	165
Labor	Connect Alarms, CO Timing & Power	1.0 hr.	$55	$55
Labor	Splice DSX Metallic Cable	1.0 hr.	$55	$55
Labor	Place DSX Cross Connections	0.8 hr.	$55	$45
Labor	Place Common Cards	0.5 hr.	$55	$55
Labor	Place Fiber Splice Panel & Splice Fibers	5.5 hrs.	$55	$300
Labor	Turn Up & Test System	3.0 hrs.	$55	$165
			Total	$20,000

Litespan 2000 Remote Terminal

Channel Bank Assembly & Channel Bank Common Cards

Channel Units, Slots 1 to 56



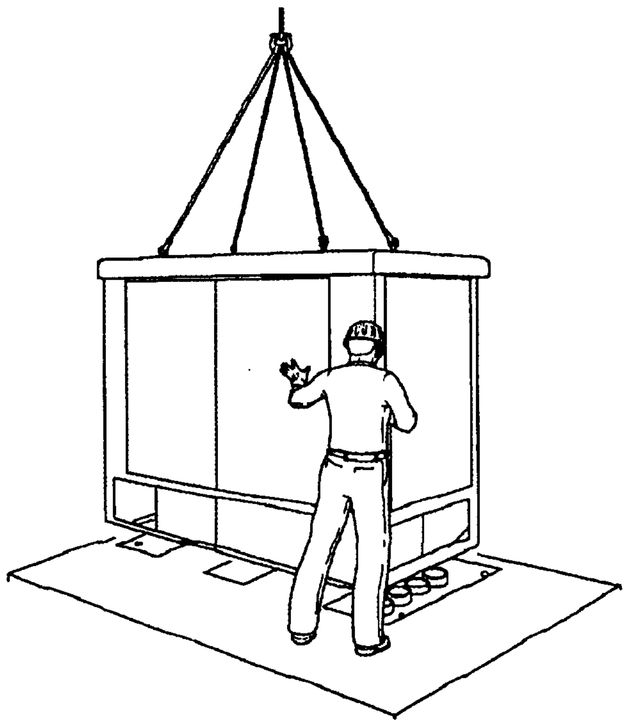
Channel Bank Commons ***$833***
BCU = Bank Control Unit
BPS = Bank Power Supply
MTAU = Metallic Test Unit
RGU = Ringing Generator Unit
CIU = Communications Interface Unit

Remote Terminal DLC Equipment				
Item	Description	Quantity	Cost	Total Cost
Matl	Common Control Bank (same as C.O.)	1 shelf	$10,000	$10,000
Matl	Cabinet / Housing, equipped at factory	1 ea.	$27,500	$27,500
Matl	Channel Bank Assembly	3 shelves	$1,333	$4,000
Matl	Channel Bank Commons	3 sets	$833	$2,500
Matl	Power Pedestal	1 set	$500	$500
Matl	Fiber Splice Panel	1 shelf	$200	$200
Labor	Engineering	32 hrs.	$55	$1,760
Labor	Construct Pad & Site	1 site	$2,000	$2,000
Labor	Place Power Pedestal & Hook Up Power	1 site	$500	$500
Labor	Place Cabinet	4 hrs.	$55	$220
Labor	Install Batteries & Turn Up Power	2 hrs.	$55	$110
Labor	Place Fiber Patch Panel & Splice Fibers	5.5 hrs.	$55	$300
Labor	Copper Splicing	4 hrs.	$55	$220
Labor	Install Common Cards	0.5 hrs.	$55	$25
Labor	Turn Up & Test System	3 hrs.	$55	$165
			Total	$50,000

Litespan 2000 Remote Terminal Cabinet Installation

Installation of a large DLC Remote Terminal is greatly simplified because the cabinet and its components are preassembled and tested at the factory. In fact, DSC, now Alcatel, states in its documentation,

> "The Litespan ... cabinet is a fully self-contained remote terminal (RT) containing Litespan-2000 channel banks and auxiliary equipment to support up to 672 POTS lines, or up to 50 DS1 or T1 lines and an additional 472 POTS lines. It is completely assembled and tested at the factory. Once the equipment is on site and bolted to its mounting pad, the only assembly required consists of connecting local power, connecting drop facilities, connecting optical fiber facilities, installing the back-up batteries, and plugging the circuit packs into their assigned locations in the racks."



> "The cabinet is prewired at the factory for DC bulk power distribution, environmental alarm reporting, temperature control, and lightning protection. Ringing power is provided by Ring Generator Units (RGU) installed in the Litespan channel banks [as opposed to a bulk ringing generator unit]. The cabinet is also provisioned for emergency battery backup and has connections for remote testing facilities."

See Appendix B spreadsheets for a quantiative cost breakdown.

4 Switching

Recent Ex Partes filed by BellSouth (December 16, 1998), Sprint (December 22, 1998, January 8, 1999 and January 26, 1999) and GTE (December 18, 1998) require the following comments by AT&T and MCI WorldCom to ensure that the record regarding switch cost inputs is balanced and complete.

4.1 Investment costs

Sprint's and GTE's primary concern appears to be with the data set proposed to be used by the Commission, and the results that it generates. They propose that a new data set should be used, based on a survey of non-rural LECs. This, supposedly, would serve two purposes: (1) Change the nature of the Commission's TELRIC cost principles to reflect an embedded life cycle analysis proposed by GTE and Sprint; and (2) "alleviate concerns that the NRRI data being considered for use in the HCPM model contains incomplete, inaccurately developed data."[29] AT&T and MCI WorldCom believe that the first of these ILECs' purposes runs counter to the goal of establishing competitively based forward-looking economic costs; and that the ILECs' second proposed objective of obtaining more accurate data is unlikely to be realized by their proposed survey methodology.

BellSouth, GTE and Sprint have provided comparisons of multiple switch cost scenarios in their several ex parte submissions. Unfortunately, these written submissions have failed to include descriptions of their arithmetic manipulations sufficient for AT&T and MCI WorldCom to determine the accuracy or appropriateness of these comparisons.[30] For example, Sprint's scenario runs do not mention whether power investments have been excluded from their HAI runs in order to make correct comparisons with the Commission data that do include power investments. Another example of the ILECs' use of questionable data for their runs is provided by BellSouth's use of data it commissioned from the Georgetown Consulting Group on BellSouth's switch additions. Apparently, these data include no instances of new switch installations, nor is there any explanation of the assumptions implicit in specific data that it chose to include. Similarly, GTE's run comparisons provide no explanation of the source or character of the GTE "actual cost" variable that it includes as a benchmark. Absent a complete disclosure of these important characteristics of their analyses, they should be given no weight.

4.1.1 Host/remote issues

AT&T and MCI WorldCom remain concerned about the Commission's potential use of embedded LERG specification of what switches should be considered as hosts, versus remotes, versus standalones. Use of embedded configurations is almost surely suboptimal from a forward-looking perspective, and will inflate calculated costs beyond what would be incurred by an efficient provider. Furthermore, certain of the current LERG CLLIs may represent wire center

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29 Sprint, Ex Parte-Errata filed December 22, 1998 Re: CC Docket Nos. 96-45 and 97-160, FCC CCB Cost Model Input Workshops-Switch Cost Inputs, Page 7.

30 See Attachment 1 of Sprint Ex Parte, GTE Exhibit 1 of GTE Ex Parte, and the last page labeled Switch Investment Cost Curves Comparison of Curve Estimates in Sprint Ex Parte.

locations where the ILEC has now substituted less expensive DLC equipment for a switch. Unless such situations are purged from the LERG data, further cost overestimates will ensue.

4.1.2 Initial/Growth lines

GTE specifically proposes using a life cycle analysis that encompasses new switch installation plus "growth" equipment. While properly and completely performed life cycle costing is generally inappropriate for TELRIC costing, it is extremely complex and has not been performed to our knowledge in any jurisdiction. Its use is inapposite if it is selectively advocated for use where it will result in higher costs. Indeed, "GTE supports a life cycle approach to *switch costs inputs*."[31] Apparently, GTE does not support life cycle costing for the modeling methodology or for any other inputs to the cost studies – only the switch inputs.

As Dr. Gabel discussed at the December 1, 1998 workshop, if life cycle analysis and growth costs were applied to other parts of the network cost studies, such as loop, the resulting cost would be lower than the current static analysis would show.[32] True life cycle costing analysis also requires sophisticated and extensive amounts of forecasting, which would add significant variability to USF costing. Arbitrarily choosing to use "life cycle" inputs just for switching is inconsistent and inappropriate.

Sprint and GTE also propose to include the price of growth equipment in their switching cost calculations. And Sprint discusses the need to include switch additions/upgrades to keep switches capable of meeting minimum industry dialing requirements. Sprint implies that these upgrades need to be "added" to the Commission's depreciation data, and raises the specter of the modeled network being incapable of meeting industry standards. This is completely mistaken. The Commission's analysis chose recently purchased switches that would have included all the equipment necessary to meet industry standards. In addition, many of the software upgrades cited by Sprint, such as 800 and Local Number Portability, international dialing strings, etc., have full recovery mechanisms provided in interstate rates set in other proceedings, and should not be included in universal service costing. In addition, because many ILECs expense software upgrades; a potential double count could occur if adjustments are made to investments to pick up costs already captured in expenses.

4.2 DLC line offset

Sprint and GTE suggest that the DLC line offset in switching costs should be eliminated. Sprint claims that for the DLC input to be usable, "the switch curves

31 GTE Ex Parte filed December 18, 1998 Re Universal Service – CC Docket No. 96-45 and Forward-Looking Mechanism for Non-Rural LECs – CC Docket No. 97-160, Page 4. Emphasis added.

32 In contrast to switching, use of a life-cycle methodology for OSP investments (which are roughly three times larger in an ILEC's capital portfolio than are switching investments) would reduce substantially calculated unit OSP costs.

would have to based on 100% analog lines."[33] This is incorrect -- which Sprint inadvertently admits when it also claims that the full DLC line offset already is inherent in the Commission's switch curve. But this is correct only to the extent that the amount of DLC in the current data set matches exactly the amount of DLC that will be employed by the SM. As AT&T and MCI WorldCom previously have explained, the SM and other proxy models all engineer *much* higher fractions of lines to be provisioned on DLC than exist even in recent historical deployments.[34] Thus, the depreciation data on switch investments cannot include all of the cost saving effects from the use of DLC calculated by the models. To accommodate this, AT&T and MCI WorldCom have recommended that the DLC cost offset to switch investments subsume only the *difference* between the historical percent of DLC embedded in the depreciation data and the forward-looking percent of DLC being provisioned by the model.

4.3 Trunk port calculations

The NBI data set used in the HAI Model stated that it assumed the cost of one trunk port for every six lines. But because the HAI Model engineers trunks by applying standard traffic engineering practices to the traffic data reported by the ILECs, this typically results in engineered line to trunk ratios between ten and sixteen.[35] Therefore, the use of the NBI data mandated this adjustment in the HAI Model.

AT&T and MCI WorldCom agree that use of the Commission's data set eliminates the need for this trunk port substitution calculation and proposes that it be deactivated in the SM.

GTE's assertion that the HAI Model produces only one trunk for every 24 lines for C&P of Maryland is incorrect – and appears to result from GTE's ignoring of the switched common and direct trunks that the HAI Model engineers in addition to the switched dedicated trunks.[36] The total number of switched trunks engineered by the HAI Model for C&P of Maryland is 301,914 trunks. When this is compared to the 3,363,270 switched lines in Maryland, a line to trunk ratio of 11.1 results. This is well within the acceptable range, as are the equivalent figures for all nonrural study areas.[37] Therefore, adjustments to any input affecting the HAI trunk port calculations are unnecessary.[38]

AT&T and MCI WorldCom also disagree with Sprint's comments that a trunk port's investment should range from $300 to $500, as well as GTE's statement that

33 Sprint, page 12.

34 The proxy models generally suggest that between 55% and 70% of all lines will be provisioned on DLC. It is unlikely that even current embedded data incorporate more than 20% or so DLC lines.

35 AT&T strongly disagrees with GTE's claim that industry standard line to trunk ratios are six to one. In fact, Sprint's own Ex Parte states that line to trunk ratios are typically in the range of 10 to 14.

36 This point was already refuted in AT&T and MCI WorldCom's earlier ex parte submission.

37 The average line to trunk ratio for all nonrural study areas in the HAI Model is 12.4.

38 GTE has proposed modifications to the BH to Total Day Ratio to artificially inflate the number of trunks being calculated.

trunk port investment should be "closer to $300 per trunk." These figures are impeached by BellSouth's August, 1998, Ex Parte which showed the following BellSouth recommended values for the trunk port:

State	BellSouth Recommended Value
KY	$62.73
LA	$63.56
NC	$110.77
SC	$89.43

The simple average investment cost that BellSouth has proposed in these states is $81.63. This highlights that the HAI value of $100 per trunk port is likely conservatively high.

4.4 *Further survey data?*

Sprint and GTE propose that a new ILEC survey should be ordered that would be more complete and accurate than the depreciation data set currently used by the Commission. At the same time, they admit that use of these "new" data would be problematic due to their proprietary nature. While this is undoubtedly true, there also is little reason to believe that these "new" data would be more accurate than what should have been filed by these ILECs in their Continuing Property Records and used in the depreciation study.

Survey data on switching already has been requested and provided in this proceeding, but it was not usable -- apparently because it was incomplete, inconsistent and potentially inaccurate. Previous survey "data" has been proffered by the BCPM sponsors claiming that per-switch fixed costs should approach $1 million, and that variable costs should be $225 per line. Sprint then suggested that its costs were closer to $140 per line. There is little reason to expect data from another ILEC survey to be superior to the existing Commission data set. There are several reasons.

4.4.1 *Long-standing embedded data are useless*

Sprint's inclusion of detailed switch price data for Nevada and their proposed "TELRIC" switching methodology change appears to be an attempt to convert TELRIC to an embedded analysis, with some investments dating from 1957. The cost of switch equipment purchased years ago, mostly before price cap regulation is next to useless for estimating forward-looking, technologically efficient switch costs.

4.4.1.1 *Will be impossible to convert to a current cost basis*

Forward-looking, economically and technologically efficient switch costs cannot be accurately estimated by applying accounting adjustments that purportedly convert the embedded base to current dollars. These accounting adjustments primarily are concerned with changes in the value of money over time and do not estimate the impacts of technological and productivity improvements that are inherent in digital switching. Converting very old, embedded switch investment to current cost through the application of factors for the purpose of "estimating" forward-looking costs that reflect the best-available technology at the most cost-efficient prices simply holds this estimation process completely hostage to the conversion process.

4.4.1.2 Will not reflect current levels of net investment

It is extremely unclear whether historical records that include older generations of digital switch equipment continue to include the costs of components that are technologically obsolete and have been replaced with newer generations of equipment – or that these records continue to reflect the true net investment in these wire centers.

4.4.2 Responses will likely be incomplete or censored

Reviewing the format of the proposed new LEC switch cost survey apparently proposed by Sprint to USTA, shows that the responses would not be detailed enough to determine whether the data is accurate, complete or relevant to universal service. The cursory nature of such a survey will ensure that will be impossible either for the Commission, or interested parties, to assess the completeness, accuracy or relevance of the ILEC data that is reported. Without an auditing mechanism to investigate in detail the reported data, its potential usefulness is simply a matter or speculation.

5 Transport and signaling

A revised Switching and Interoffice module is being provided to the Commission staff to reflect better economic forward-looking principles and input values.

6 Expenses

Sprint's filing of December 22, 1998, stated that the appropriate value for Network Operations Expense is $3.00/line per month -- despite of the BCPM default value of $1.33. The HAI sponsors pointed out that their choice of an 80% factor to allocate costs to universal service was greatly in excess of the relative fraction of switching minutes associated with basic local service. Furthermore, the effect of this error *alone* was to inflate network operations expense attributable to universal service and driven by switching by 35%.

Since that time, Sprint has redone their analysis, relying now on purported call volumes to support their large allocation of these expenses to universal service. Unfortunately, Sprint continues to make the same error previously pointed out to them – their data weight intra-switch calls (which are exclusively local calls) the same as inter-switch calls.[39] But because inter-switch calls require far more network resources (e.g., switching, transport and signaling) than to intra-switch calls,

[39] Roughly, 45% of all local calling is intra-switch.

weighting them equally will cause a large and unwarranted over-allocation of network operations expense to universal service. This over-allocation is likely further compounded by Sprint's error in also equating the network resources associated with local call attempts and completed toll calls.

Unfortunately, AT&T and MCI WorldCom could assess readily only the validity and consistency of these traffic data components of the Sprint analysis. The rest of its analysis relied on proprietary data that are not amenable to critical review.

7 Depreciation

The Commission staff has requested an HAI expense module that incorporates both the effects of IRS accelerated depreciation for tax purposes and straight-line Equal Life Group depreciation for regulatory purposes. This will be available shortly.

Appendix A

25-Pair Unit PIC Cables

DUCTPIC® (Air Core) Bonded Stalpeth

AT&T 626-101-005, 626-WIP-004

DUCTPIC is color-coded PIC cable used where large paired cable is required in the underground system.

DUCTPIC (AIR CORE) BONDED STALPETH								
Cable Code	No. Of Pairs	AWG	Availability	Standard Length #420 Reel Ft.(m)	Nominal Outside Dia. In.(mm)	Nominal Weight Lbs./Ft.	Nominal Weight Gr./m	Comcode
DCAZ	0900	22	NS	1320(403)	2.55(65)	4.40	6548	106389836
	1200	22	NS	1000(305)	2.88(73)	5.79	8616	105486146
DCMZ	0600	24	NS	2500(763)	1.74(44)	1.95	2902	106202609
	0900	24	NS	2000(610)	2.11(54)	2.80	4167	106202625
	1200	24	NS	1660(506)	2.33(59)	3.74	5566	104246749
	1500	24	NS	1320(403)	2.55(65)	4.61	6860	103716692
	1800	24	NS	1100(336)	2.84(72)	5.49	8170	103716700
	2100	24	NS	880(269)	3.02(77)	6.37	9479	103716718
	2400	24	NS	820(250)	3.23(82)	7.24	10774	103716726
DCTZ	0600	26	NS	3500(1067)	1.41(36)	1.30	1935	106201437
	0900	26	NS	2800(854)	1.65(42)	1.86	2768	106202633
	1200	26	NS	2310(705)	1.88(48)	2.41	3586	103175147
	1500	26	NS	1980(604)	2.10(53)	2.98	4435	105485866
	1800	26	NS	1730(528)	2.28(58)	3.52	5238	103175154
	2100	26	NS	1390(424)	2.44(62)	4.10	6101	105485874
	2400	26	NS	1390(424)	2.55(65)	4.64	6905	103175162
	2700	26	NS	1150(351)	2.78(71)	5.19	7723	103733242
	3000	26	NS	1070(327)	2.92(74)	5.75	8557	103175170
	3300	26	NS	1070(327)	3.01(76)	6.32	9405	105485890
	3600	26	NS	860(263)	3.10(79)	6.86	10209	103175188
	3900	26	NS	860(263)	3.25(83)	7.42	11042	105485916
	4200	26	NS	810(247)	3.35(85)	7.98	11875	103175196

Notes:

1. AWG metric equivalent: 22 Ga = 0.6 mm, 24 Ga = 0.5 mm, 26 Ga = 0.4 mm.
2. Pulling eye available on all pair sizes.
3. Longer lengths are available: contact an AT&T Sales Representative.

GF-TYPE ASP SHEATH (FILLED)
DEPIC NONSCREENED (Contd)

Cable Code	No. Of Pairs	AWG	Availability	Standard Length #420 Reel Ft.(m)	Nominal Outside Dia. In.(mm)	Nominal Weight Lbs./Ft.	Gr./m	Comcode
GFMW	0025	24	S	15050(4587)	0.61(15)	0.21	313	106583909
	0050	24	S	15050(4587)	0.77(20)	0.33	491	106583917
	0100	24	S	10000(3048)	0.99(25)	0.55	818	106583933
	0200	24	S	6040(1841)	1.29(33)	0.97	1443	106583958
	0300	24	S	3780(1152)	1.48(38)	1.38	2054	106583966
	0400	24	S	3775(1151)	1.65(42)	1.75	2604	106583974
	0600	24	S	2260(689)	2.01(51)	2.59	3854	106583982
	0900	24	S	1675(511)	2.41(61)	3.80	5655	106584154
	1200	24	S	1255(383)	2.93(74)	4.97	7396	106584162
	1500	24	S	1005(306)	3.02(77)	6.18	9197	106584170
	1800	24	S	820(250)	3.30(84)	7.24	10774	106584188
GFTW	0025	26	S	30050(9159)	0.59(15)	0.17	253	106584709
	0050	26	S	15050(4587)	0.68(17)	0.24	357	106584717
	0100	26	S	15050(4587)	0.83(21)	0.37	551	106584733
	0200	26	S	9500(2896)	1.07(27)	0.66	992	106584758
	0300	26	S	6690(2039)	1.19(30)	0.94	1399	106584766
	0400	26	S	5470(1667)	1.37(35)	1.15	1711	106584774
	0600	26	S	3340(1018)	1.63(41)	1.73	2574	106584782
	0900	26	S	2510(765)	1.93(49)	2.47	3676	106584790
	1200	26	NS	1641(500)	2.11(54)	3.29	4896	106584808

PE-89 REA LISTED FILLED CABLE WITH COATED ALPETH SHEATH (Contd)

Cable Code	No. Of Pairs	AWG	Availability	Standard Length #420 Reel Ft.(m)	Nominal Outside Dia. In.(mm)	Nominal Weight Lbs./Ft.	Nominal Weight Gr./m	Comcode	Std. Reel Size
WA4AR	0006*	24	S	10000(3048)	0.44(11)	0.09	134	105185052	3A5
	0012*	24	S	10000(3048)	0.48(12)	0.11	164	105185078	3A5
	0025	24	S	10000(3048)	0.58(15)	0.16	238	105185110	3E6
	0050	24	S	10000(3048)	0.70(18)	0.27	402	105185144	3E6.5
	0075	24	NS	5000(1525)	0.86(22)	0.48	714	105185169	3E6
	0100	24	S	5000(1525)	0.94(24)	0.48	714	105185268	3E6.5
	0150	24	NS	5000(1525)	1.06(27)	0.70	1042	105185276	3E0
	0200	24	S	5000(1525)	1.20(30)	0.88	1310	105185284	3E0
	0300	24	S	2500(1278)	1.45(37)	1.27	1890	105185292	3E6.5
	0400	24	S	2000(610)	1.59(40)	1.66	2470	105185300	3E6.5
	0600	24	S	2000(610)	1.92(49)	2.39	3557	105185318	3E0
	0900	24	S	1000(305)	2.32(59)	3.28	4881	105185326	3E0
	1200	24	S	1000(305)	2.68(68)	4.70	6994	105185334	3E0
	1500	24	NS	1000(305)	2.92(74)	5.80	8631	105185375	3E0
	1800	24	NS	750(229)	3.20(81)	7.14	10625	105185383	3E0
	2100	24	NS	600(183)	3.44(87)	7.27	10819	105423321	3E0
WA6AR	0025	26	NS	10000(3048)	0.52(13)	0.13	193	105187207	3A5
	0050	26	NS	10000(3048)	0.58(15)	0.19	283	105187264	3E60
	0100	26	NS	10000(3048)	0.78(20)	0.33	491	105187330	3E0
	0200	26	NS	5000(1525)	1.02(26)	0.60	893	105187405	3E6.5
	0300	26	NS	5000(1525)	1.18(30)	0.85	1265	105187439	3E0
	0400	26	NS	5000(1525)	1.33(34)	1.10	1637	105187454	3E0
	0600	26	NS	2500(763)	1.59(40)	1.58	2351	105187488	3E0
	0900	26	NS	2000(610)	1.92(49)	2.27	3378	105187538	3E0
	1200	26	NS	1500(458)	2.10(53)	3.29	4896	105187579	3E0
	1500	26	NS	1000(305)	2.34(59)	3.93	5848	105187595	3E0
	1800	26	NS	1000(305)	2.60(66)	4.63	6890	105187637	3E0
	2100	26	NS	1000(305)	2.78(71)	5.11	7604	105187660	3E0
	2400	26	NS	1000(305)	2.92(74)	6.01	8944	105188122	3E0
	2700	26	NS	750(229)	3.14(80)	6.77	10075	105188148	3E0
	3000	26	NS	750(229)	3.24(82)	7.20	10715	105188155	3E0

* Pulling eyes not available in these pair sizes.
Longer lengths are available: contact an AT&T Sales Representative.
AWG metric equivalent: 19 Ga = 0.9 mm, 22 Ga = 0.6 mm, 24 Ga = 0.5 mm, 26 Ga = 0.4 mm.

Appendix B

High Density GR-303 IDLC

TEMPLATE FOR DETERMINING DLC COST

Remote Terminal

Item	Unit Cost	Quantity	Material Cost	Labor	Installed Cost	Comments
Pad and Site						
Pad and Site				$2,000	$2,000	
Remote Cabinet and Equipment:						
Cabinet / Housing	$27,500	1	$27,500	$2,365	$29,865	Includes: 32 hrs. Engrg. @ $1,760; + 4 hrs. Place Cabinet @ $220; + 4 hrs. Copper Splicing @ $220; + 3 hrs. Turn Up & Test System @ $165.
Line Interface Unit Line Suppressor Unit Signal Processing Unit						$1,850 included in Cabinet / Housing.
Common Control Shelf Assembly						Shelf Assembly is factory installed (included in Cabinet / Housing cost). See Fiber Optics Multiplexer, below, for Plug-In cards.
Channel Bank Assemblies	$1,333	3	$4,000		$4,000	Shelf Assembly is factory installed (included in Cabinet / Housing cost). See Channel Bank Assembly, below, for Plug-In cards.
Fiber Splice Panel	$200	1	$200	$300	$500	Identified separately in HAI Model as $1,000 for CO + RT.
Power Shelf and Panel:						
Power Pedestal	$500	1	$500	$500	$1,000	Identified separately in HAI Model as part of Pad & Site.
Power / Rectifier Shelf and Rectifiers Batteries Power Distribution Panel:				$110	$110	Includes 2 hrs. to place batteries and turn up power. Material included in Cabinet / Housing Cost.
Fiber Optics Multiplexer:						
Optical Receiver Unit Optical Transmitter Unit	$2,250	2	$4,500	$2	$4,502	Normally negotiated at a package price.
Time Slot Interchanger	$1,750	2	$3,500	$2	$3,502	
SONET Ring Formatter Unit Timing Control Unit Terminal Control Processor System Backup Memory Datalink Controller and Tone Generator Common Power Supply Alarm Control Unit Maint. And Test Interface System Communication Unit (TR303)	$1,000	2	$2,000	$7	$2,007	Normally negotiated at a package price.

High Density GR-303 IDLC

Item	Unit Cost	Quantity		Material Cost	Labor	Installed Cost	Comments
				Channel Bank Assembly:			
Bank Control Unit (BCU) Bank Power Supply (BPS) Metallic Test Access Unit (MTAU) Ringing Generator Unit (RGU) Communications Interface Unit (CIU)	$833	2 3 1 2 1	x3 sets	$2,500	$14	$2,514	Normally negotiated at a package price.
Remote Terminal Total				***$44,700***	***$5,300***	***$50,000***	
Channel Unit Interface-POTS	$310	1		$310		$310	
Note number of units per card		4					

High Density GR-303 IDLC

Item	Unit Cost	Quantity	Material Cost	Labor	Installed Cost	Comments
			Central Office Terminal			
			Hardwired Equipment:			
Bay Assembly (specify size) Rack Full Electrical Cabling	$7,000	1	$7,000	$1,045	$8,045	(7 ft. Bay height) Includes: 12 hrs. Engrg @ $660; + 3 hrs. Place Frames & Racks @ $165; + 1 hr. Connect Alarms, CO Timing & Power @ $55; + 3 hrs. Turn Up & Test System @ $165.
Common Control Shelf Assembly						Included in Rack and Bay Assembly
Fiber Jumpers Fiber Patch Panel	$200	1	$200	$300	$500	Identified separately in HAI Model as $1,000 for CO + RT.
DSX-1 Panel	$800	1	$800	$100	$900	Includes: Splice DSX Metallic Cable @ $55; Place DSX Cross Connections @ $45
Line Interface Unit Line Suppressor Unit Terminal Block						$1,850 included in Bay Assembly.
			Fiber Optics Multiplexer:			
Optical Transmitter Unit Optical Receiver Unit	$2,250	2	$4,500	$10	$4,510	
Time Slot Interchanger	$1,750	2	$3,500	$5	$3,505	
SONET Ring Formatter Unit Timing Control Unit Terminal Control Processor System Backup Memory Datalink Controller and Tone Generator Common Cards w/ Optics Common Power Supply Alarm Control Unit Maintenance and Test Interface System Communications Unit	$1,000	2	$2,000	$20	$2,020	Normally negotiated at a package price.
			Channel Bank Assembly:			
Bank Control Unit Bank Power Supply	$500	1 1/6	$500	$20	$520	Normally negotiated at a package price.
			DS-1 Switch Interface Unit			
DS-1 Switch Interface Unit Number DS-1's per Card						$240 / CO DS1 Low Speed Card included in POTS Card Cost.
Central Office Terminal Total			***$18,500***	***$1,500***	***$20,000***	
Note number of RTs served by one COT.		1				
COT + RT Total			***$63,200***	***$6,800***	***$70,000***	HAI Defaults = $66,000 COT+RT; $3,000 Site; $1,000 Fiber Panel

New HAI Components for FCC Synthesis Model

HM Revisions.MDB:

Tables

Expense Inputs : Sharing set to 100%

LERG Host/Remote: Populated with 8/1/97 LERG collection of host/remote relationships created with Automated LERG query filed with the FCC in 1998.

WC Inputs: Modified to be consistent with the new SW IO module's interoffice calculations/features (highlighted in HAI Model sponsors ex-parte filing of 12/24/98)

Queries

GetLERGHostRemote: Extracts Host remote list for given NECA ID

Series of queries which reflect variation in "Investment Input" sheet design to accommodate extra columns to pass structure sharing fractions to allow the WC module to accept WC-specific sharing fractions as well as WC-specific signaling counts
Total_ Network_ Invest_ By_CBG
Total_ Network_ Invest_ By_density_non_slc
Total_ Network_ Invest_ By_ By_density_ slc
Total_ Network_ Invest_ By_wirecenter

Form
frmcopyright: Intellectual property statement

Macro
Autoexec: Automatically bring up intellectual property statement

hmxldb dz by WC.xls:

Interface template file which reflects variation in "Investment Input" sheet design to accommodate extra columns to pass structure sharing fractions to allow the WC module to accept WC-specific sharing fractions as well as WC-specific signaling counts

Distance_Files_FCC.ZIP:

Revised set of distance files modified to facilitate the new interoffice concepts

Master.xls:

Revised Ring_io VBA module to 1) accommodate revised interoffice process, 2) revised column structure, 3) LERG processes, efficient operation ...

RFCC_expense_density.xls:

See expense module changes document

RFCC_expense_wirecenter.xls

See expense module changes document

RFCC_switching IO .xls

Updated for new interoffice process, structure sharing changes, and signaling link calculations.

New HAI Components for FCC Synthesis Model

workfile5.xls

Revised workfile structure to accommodate changes in formats.

New HAI Components for FCC HAI Model

HM Revisions.MDB:

Tables

Expense Inputs : Sharing set to 100%

LERG Host/Remote: Populated with 8/1/97 LERG collection of host/remote relationships created with Automated LERG query filed with the FCC in 1998.

WC Inputs: Modified to be consistent with the new SW IO module's interoffice calculations/features (highlighted in HAI Model sponsors ex-parte filing of 12/24/98)

Queries

GetLERGHostRemote: Extracts Host remote list for given NECA ID

Series of queries which reflect variation in "Investment Input" sheet design to accommodate extra columns to pass structure sharing fractions to allow the WC module to accept WC-specific sharing fractions as well as WC-specific signaling counts
Total_ Network_ Invest_ By_CBG
Total_ Network_ Invest_ By_density_non_slc
Total_ Network_ Invest_ By_ By_density_ slc
Total_ Network_ Invest_ By_wirecenter

Form
frmcopyright: Intellectual property statement

Macro
Autoexec: Automatically bring up intellectual property statement

hmxldb dz by WC.xls:

Interface template file which reflects variation in "Investment Input" sheet design to accommodate extra columns to pass structure sharing fractions to allow the WC module to accept WC-specific sharing fractions as well as WC-specific signaling counts

Distance_Files_FCC.ZIP:

Revised set of distance files modified to facilitate the new interoffice concepts

Master.xls:

Revised Ring_io VBA module to 1) accommodate revised interoffice process, 2) revised column structure, 3) LERG processes, efficient operation ...

RFCC_expense_density.xls:

See expense module changes document

RFCC_expense_wirecenter.xls

See expense module changes document

RFCC_feeder.xls

Performs the calculations to develop the WC-specific structure sharing %

New HAI Components for FCC HAI Model

RFCC_switching IO .xls

Updated for new interoffice process, structure sharing changes, and signaling link calculations.

wftemplate.xls

Revised workfile structure to accommodate changes in formats – new reserved name recognized by new master.xls.